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ABSTRACT

This paper investigates a collaboration between faculty and students in a college statistics course to develop a method of quickly getting homework graded with feedback indicated and returned to the students. Using a World Wide Web site to deliver this support was a possible solution. A survey was developed to gain student input in the process of creating a computer assisted homework site. The survey asked students to reply to ten questions that addressed the following issues related to homework: reasons for homework; student expectations of the instructor with regard to processing homework; percentage of grade; whether they would use a Web site; how should it be designed; submission; type of feedback; improvement of teaching practice opportunity; and instructor feedback. The first attempt at creating a homework Web site used information gained from the responses of the survey. The Web site design was created to be user friendly by not making major changes from the previous paper and pencil form. The software used was Microsoft Access and FrontPage. Further developments are being created to include animation and audio during the feedback to students. (Contains 14 references.) (MES)

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Using Action Research to Create a Computer-Assisted Homework Site.

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Using Action Research to Create a Computer-Assisted Homework Site.

Traditionally mathematics classes assign students with homework to practice the concepts being taught in the classroom. If homework is to be valuable to the student's learning it needs to be graded and feedback given. For an instructor with more than 150 students, this means an additional 25 hours or more per week. One solution to the homework load was developed by Weems (1998) - using a homework notebook, which was graded during quizzes and exams. She encountered two different problems using this style: 1) not enough time during exams periods and 2) students did not follow directions. This paper chronicles the investigation of a collaboration between faculty and students to develop a method of quickly getting homework graded with feedback indicated and returned to the students. Using a Web Site to deliver this support was a possible solution. A survey was developed to gain student in put in the process of creating a computer assisted homework site.

Statistics is a course which intimidates and strikes fear into the hearts of many students (Potter, 1995). Students' views were stated in the preface of Keller, Warrack, & Bartel's (1988) first - year statistics text:

> "While the material covered, the level of difficulty, and the approach vary enormously, most have one aspect in common; the course is typically the most unpopular in the academic program."

Work by others has suggested that there are methods to reduce statistical anxiety (Royse & Rompf, 1992) (Schacht & Stewart, 1992). Like any new material and language, a period of adjustment needs to occur, and practice makes this transition easier.

Homework allows the student to practice what has been introduced in the classroom. A correlation between student grades on homework and their final exams scores suggests a strong influence of homework on the student's final grade This correlation was true for both university students as well as community College students as shown in the table below.

Table 1. Correlation between homework and Final grade

	r	R^2
University	.869	.755
Community College	.876	.768

Included in a list of suggestions to improve learning was the use of frequent practice (Neill, 1998) . Neill states that learning activities accomplish two functions: "help learners acquire information or cause learners to practice". Elaborative rehearsal in the form of problem solving causes the learner to become involved with the content. Regardless of preparation, the argument put forth by Carroll, (1963) suggests that learning is function a ratio of time spent studying content to the time needed by each individual student to learn the material. It is the idea that access to information in a timely manner would allow students to maintain contact with the material. Problems simulating studies done in the fields of social work, psychology, and business aid the students in understanding the relevance of the material. These simulations allow the student to discover how to find the appropriate pieces to the problems and answer the question. Work using computer simulations has been done to replicate this scenario (de Jong & van Joolingen, 1998). Software has also been developed and used to help individuals master basic concepts such as programs like "Question Mark" used by Luyben (1998) .

Student comments (Mory, Gambill, & Browning, 1998) suggest that using online sources created a problem of individual pacing and effort for them to keep to schedule. Part of this dilemma was the format of delivery (text and graphic) demanding more time to study. Others suggest for developing online courses designers should include employing a variety of teaching methods (textual, audio, visual, email, group discussions) (Everett, 1998). Consideration also must be given to the student location and their characteristics (Lehman, Newby, & Ahn, 1998). Part of the solution is to cultivate independent and self-directed learners (Kao & Lehman, 1997). They suggested a scaffolding design with decreasing support levels. They went on to suggest that the support level can be adjusted based on the student's ability level, measured by the number of corrections on assignments/quizzes. These would help those students needing feedback to aid their progression through the course. Teaching systems of investigation to these students, especially in courses such as statistics, by the use of framework guidelines would aid student performance (Lool, 1998). Self-regulated students would need less of the support system as they are largely intrinsically motivated (Winne, 1995).

The first attempt to reduce homework load for the instructors was to abolish the written homework assignments by the students. The common difficulty, which faces all mathematic teachers, is finding the answer among the calculations. A solution was to create multiple choice answer sheets (See Appendix A). After years of teaching, the knowledge of common mistakes allowed a host of alternative incorrect solutions to each problem. Homework was submitted by students using a computer analyzed sheets created by a national company. By using an optical scanner to grade the

homework assignments, the time was reduced from many hours down to minutes. Since it is the belief of this instructor that homework is an extension of the classroom, learning should continue. Handing back a sheet of scanned answers only told the student what was correct or wrong. Without further investigation by the student the learning process was absent. But it did give the instructor the understanding of the problems, that gave the students the most trouble, which then could be addressed before the quiz. Development of a more complete system of helping students with their homework needed to be created.

Since students would be the users of a web site for homework, their input was important to consider during the design phase. One hundred and ten Introductory to Statistical methods students participated. As part of their coursework, they were asked to use answer a survey of 10 questions about on-line homework assignments, purpose, possible use, and their expectations. Previous knowledge of the students had been gained in an earlier survey about their mathematics and computer exposure.

Table 2: Self-reported student experience prior to the statistics class reported by numbers (percentage)

	No Experience	Little experience	Some experience	Lots of experience
Computers	1 (1%)	57 (52%)	37 (34%)	15 (13%)
Mathematics	3 (2%)	37 (34%)	63 (58%)	7 (6%)

By their report, the students were exposed to both mathematics and computers in a limited fashion. Statistics requires student to think through

problems seeking the information they have to work with and attempting to solve what they do not know. This skill is only learned through practice. Since it was important to involve students in the actual performance of manipulation of statistical concepts, homework was assigned each week. Homework assignments were assigned and students were given the following rules as stated by the course syllabus.

Homework:

Must be handed in on time for full credit
More than one week late value is reduced by 50%
Each assignment will be graded and handed back with correct answers
Students will use NSC answer sheet to hand in homework assignments.
Assistance will be available any time before due date from the instructor or academic student services without penalty to grade. You may correct your homework mistakes before handing in your assignments
Homework is to prepare the student for quizzes, therefore homework not handed in by the quiz on that material would not be graded

So the next stage in the evolution was to allow students to check their homework before turning it in for credit and a grade. The complete set of homework problems were done step-by-step and placed in several homework books found in the instructor's office, the mathematics lab and the Student Support Services lab. This process gave the conscientious student the access and opportunity to gain immediate feedback while checking the assignment. The students liked this idea and some took advantage of the process. It became an opportunity to further learning without any penalty

Students checking homework created two new problems. The first was it removed the mistakes of the students from the eye of the faculty member reducing the opportunity for highlighting the common errors. As

some students always check homework before handing in assignments, homework appears to the instructor as whole and correct. It also created an apparent time problem for students to find the source of the correct homework, even though it was available at three different sites on campus. With a majority of students working multiple hours outside of schoolwork, checking homework was not always possible in the time they allotted themselves to be at school. The few students who do not avail themselves of the option to check their homework lose a valuable opportunity to get feedback on the easily correctable errors often made on homework assignments. Without the practice and feedback there was little opportunity for faculty to assess the weekly teaching effectiveness until the next quiz or test.

Shortness of time for both student and instructor made having homework solutions available online a possible remedy. The teachers held ideals of what the on-line site could contain: access 24hours a day, easy of checking answers, immediate feedback for the students, a record of attempts by each student, the ease of entering new problems and solutions. This would reduce the time for grading papers, but at the same time allow for determination of the concepts not well understood by the student. But what did the students want?

The survey asked students to reply to ten questions related to homework: reasons for homework, expectations of instructor related to homework, percentage of grade, would you use a web-site, how should it be designed, submission, type of feedback, improvement of teaching practice opportunity, and instructor feedback.

The first question asked " **What do you see as the most important reasons for having homework assigned in a class of statistics?"** Reflecting on responses, students appear to comprehend the purpose of homework. It appears the students felt that it is neither a waste of their time nor some diabolical invention of their instructor. In spite of taking a lot of their time, it appears to be appreciated. One student suggested " *You can take all the notes you want in class, but you really won't understand it until you work them out in your HOMEWORK. Making test day much easier."* Another student's statement understood completely the purpose of homework. " *The most important reason for assigning homework would be that we are able to go over problems and help us learn what to do with the problems. Also if we have any questions about what we are covering this might help clear it up and be able to ask the instructor any extra questions. It helps you try to teach yourself and helps you understand more, instead of the teacher just doing it."* Some of the simplest responses often got right to the purpose of homework in a mathematics course such as "*Repetition breeds confidence" and "Practice makes ALMOST perfect."*

The student's responses to the second question led to the guidance of the future web site. The second question asked: ***"What expectations do you have of your instructor with regards to his/her processing of your homework?"*** Expectations came in four themes: time, feedback on mistakes, homework and the teacher, and thoughts about teachers in general.

Students felt that time was important when considering a change in how the homework is processed and returned. Some of the responses demonstrated how students felt about the timing of homework return in

their short responses: "*...return it in a timely manner...*" "*...before the next test...*" Responses given by the instructor in terms of feedback would be most beneficial to "*...help me understand where I made mistakes...*" It was suggested by students that the professor make "*...stats dummy proof.*" While the students were discussing homework, they had several suggestions for the teacher and how they instructed students. They thought it would be good if instructors used homework to guide the class by finding "*...the common problems areas in the class... and reworking these areas in class*" or "*...going over that particular problem.*" Advice for teachers went on to suggest that special attention be given to "*difficult problems on the homework assignment...*" which the teacher could understand and demonstrate before the assignment was given. Students offered advice when planning a web site "*I expect the teacher to remember what being a student was like.*" After teaching a subject long enough, the answers seems so very simple to the teacher, which is not the perception held by the students.

Question three asked the students: ***If you were to set the value of homework, what percentage of your grade would it be and why?*** Their responses followed that effort increases in doing homework when it has value. "*...it makes students put more effort in their homework and trying to understand what is being taught, rather than just going through the motions thinking that homework doesn't matter.*" and "*...high enough to force students' hands to do it.*" The value of homework's value alters normal student behavior as stated, "*not many of us would take the time to go through and solve problems to make sure we understand them.*" Students seem to state what has been heard from instructors when it comes to

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homework. "*If it isn't mandatory it won't be done by most. People need incentive-motivation.*" But according to the survey, the value of the homework assignment is not just in the points, which are gained, but there are intrinsic motivations as well. "Homework is also the key to doing good on test and quizzes." "*Working and reworking the problems is the only way most individuals are going to begin to understand statistics.*"

The fourth question sought to find out if students would use the web site. **If you were to design the way your homework assignments could be checked before you handed them in, would you use the web site? Yes or No and why?** Responses suggested that the web site would help learning, has convenience, but it has a negative side. By having the availability of a web site with homework, "*I could see if I was doing something wrong and get the right answer and know how to do the problem.*" "*If I'm working on a problem at night I could just get the answer right away instead of trying to figure it out the next day.*" By seeing solutions to a problem I "was stuck on" I could finish my work without frustration. The solution should have "*...a diagram, showing how to complete the problem...*". The web site would "*be very convenient.*" Time on campus can be short for working students so the web site would be a solution. "*I can't always take time to see the professor and check my homework but the availability on the computer would help.*" "*On the internet, anyone can check answers anywhere.*" Not all responses were positive since more than 54% of the students do not own a computer capable of accessing the Internet. "*I would not use the Internet because I don't have the Internet at home, and it is hard for me to find time to use it.*" "*I don't have access to a computer unless I come to campus...*" "*Internet access is a problem for us old fashioned people.*" Student even suggested

some warnings *"I think if students don't try to cheat themselves by copying the answers, it would be very helpful." "No, because you could just get the answers before you did the work, you wouldn't learn anything."*

Question five looked at the desire for students to use a web site. It stated: **Would you be willing to use this web site to check your answers?** The responses fell into the two division of having or not having the access to a computer. The theme held by positive responses suggested *"...it would be much more convenient".* The thought of decreasing frustration also reoccurred with statements such as *"...when doing my assignment and I get stuck...I could come to this web site and see the method of solution...it would help me reach the correct answer on my own."* The negative responses were statements of unfamiliarity of computers and the web or the lack of access. *"I would rather check my answers on a sheet of paper than on a web-site." "I would if I had access to a computer." "No, it requires a special trip to town to use a computer."*

Question six continued to look at student willingness to use a web site for homework. **If you were given a place to submit your homework on-line, would you use it?** As with question five, the answers were divided along the lines of availability or familiarity. *"I always worry that things will get lost when using the computer." "If I had a computer." ...I do not feel comfortable enough with my computer skills."* For those with access, the idea was appealing. *"It would be nice to submit it online and not have to worry about it." "I like the computer plus it would cut down on paper work and I would not be confined to a particular hour to turn it in." "Yes, it would be easier than handing it in because I forget a lot to hand stuff in."*

It was also important to gain insight to how the students would create the web site that they would be asked to use. Question seven addressed that issue: **If you were to write the structure for a homework section on the Web, what type of information would you like to find there?** Information gained through this question allowed other parts of the web site to be altered as well as improving the homework segment. These additional improvements to the web site include segments which would demonstrate sample problems, have lecture notes, present real life examples of uses, vocabulary and a page dealing with equations. Homework suggestions included practical additions such as: "*answers and solutions, the ability to find and point out mistakes.*", "*...detailed solutions with the work shown,...show(ing) current grade would be a plus.*"

It was felt that it was important to see what the students felt the connection between the teacher and homework might be. Question eight: **Do you believe that an instructor should use homework to improve teaching?** The responses demonstrated that some students do understand the relationship between homework and the classroom. Homework helps the teacher "*...by seeing their {students} problems and perhaps even help him know what he should have emphasized more in class.*" "*Yes, when your class is required to do homework and you go over it and explain it, then you are aiding lectures. It helps to understand the material. I think it definitely improves the course.*"

It was also felt that the connection which students might see between themselves and homework. Question nine: **Do you believe that homework is a practice opportunity for students?** The response themes were that homework aided the preparation for tests and the gaining of

knowledge. *"I do believe that homework is a practice for students to get ready for an exam, and to understand what they are doing." "Some of my classes just have tests, and I don't do as well in those classes."* Homework gives the student *"an opportunity to find out what they're doing wrong before having to take a test."* Related to the performance measures of the test is the value of learning the material. *"Doing assignments will strengthen knowledge by repetition." "Homework refines your skills and understanding of the subject." "It is like riding a bike, if you do not practice over and over, you won't learn."*

The value of feedback to students was investigated by the last question: **Do you believe that homework gives the instructor the opportunity to give feedback to students about their efforts?** By allowing students to freely access the correct answers, some students never get feedback. *"Because a student can get answers so the instructor never knows if they (students) really understand what is going on, and then the instructor only finds out how the student is doing from the tests which are given."* How teachers give back feedback is not consistent *" Homework will give the instructor an idea of progress in the grade book, but many instructors don't have the time to give students feedback." It would if all instructors gave feedback."* Feedback is felt by students as taking two forms, ith one aiding the student and the other to aid the instructor. *"Knowing that a professor is quite available to answer your question puts more responsibility on a person's shoulders. There is no excuse for not understanding the material." "They (students) either want to learn or they want a free ride. If they want to learn then it will be important to them to get that feedback, if they just want to get it over with they won't be*

concerned at all about how their homework turns out." "Homework is an opportunity for the instructor to continue the learning process by giving feedback." Feedback to the instructor comes in various forms. *" The instructor can tell by the effort on our (students) homework how much we care and how much time we take to make sure we are doing things right." "Possibly because someone isn't trying their hardest maybe the instructor can recognize that and possibly help turn their efforts around for the better." "Homework is an opportunity for the instructor to continue the learning process by giving feedback."*

The first attempt at creating a homework web site took form using information gained from the responses of the survey. The design was created to be user friendly by not making major changes from the paper and pencil form in use previously. The first attempt was using FrontPage and Access products of Microsoft. The questions and the solutions were entered into an Access database. This would allow students to click on the appropriate chapter, enter their solutions into the same multiple answer format, which they had been using. Once entered, the answers would be automatically graded and the response of correctness would be delivered on screen. It would list all of the problems whether it was correct or incorrect. This first result would be sent to the faculty member as an email. The student would be given with the opportunity to receive feedback. The correct solution to any problem which had been graded incorrect could be displayed on screen or printed out as an aid for the student to determine the correct solution. The student could then resubmit their answers for final grading. The final answers graded would also be sent to the professor by email.

The professor by receiving the first submission would have the opportunity to see where the mistakes were being made. This allows the instructor to return to the classroom with knowledge of the areas where students struggled. This advantage was not available when students could use the homework book to check answers, as the instructors never saw the incorrect answers. It also addressed one of the issues brought up by the students, the possibility of cheating. The students have to enter a complete set of answers in order to find the results. It would be very obvious to the instructor if a student just entered any answer to attempt to gain the correct answers. Ultimately, the student just cheats himself or herself by obtaining answers in this fashion. It will definitely show up on the quiz. The second submission was pre-graded for entering into the grade book.

With further developments of the transmission of class aids to the student via the Internet will reduce student frustration levels with statistical class. Lehman, Newby, & Ahn, (1998) went on to suggest that understanding the subject matter and the delivery techniques are equally important. Some present strategies are confined by technology, space and time. Technology such as audio can aid the understanding of individuals. In a study (Mayer & Moreno, 1998) implied that students learn better in a multimedia environment when words and pictures are presented at the same time. The student's ability to receive these mediums would influence their ability to avail themselves of the technology and cognitive advancements.

Further developments are being created to include animation and audio during the feedback to students.

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Appendix A

Example of multiple choice questions which students have to enter their homework

1) **Problem 8, select the correct hypotheses.**
   - **a)** H_0: $\mu \geq 100$ H_1 $\mu < 100$
   - **b)** H_0: $\mu = 100$ H_1 $\mu \neq 100$
   - **c)** H_0: $\mu = 100$ H_1 $\mu \neq$ 97.3
   - **d)** H_0: $\mu \leq 100$ H_1 $\mu > 100$

2) **Problem 8, select the correct critical boundaries.**
   - **a)** $\pm$ 2.58
   - **b)** +1.65
   - **c)** - 1.65
   - **d)** $\pm$ 1.96

3) **Problem 8, what is the value of the error term**
   - **a)** 15
   - **b)** 3.35
   - **c)** 4.47
   - **d)** 20

4) **Problem 8, determine the z-score**
   - **a)** - 0.18
   - **b)** - 0.80
   - **c)** - 0.604
   - **d)** - 0.135

5) **Problem 8, make a decision about the null.**
   - **a)** Accept H_0
   - **b)** Reject H_0
   - **c)** Accept H_1
   - **d)** Reject

Feedback which is given at the student's request

8. IQ scores for the general population form a normal distribution with μ = 100 and σ = 15. However, there are data that indicated that children's intelligence can be affected if their mothers have German measles during pregnancy. Using hospital records, a researcher obtained a sample of n = 20 school children whose mothers all had German measles during their pregnancies. The average IQ for this sample was $\bar{X}$ = 97.3. Do theses data indicate that German measles have a significant effect on IQ? Test with α = .05.

a. Four step solution

1. H_0: $\mu = 100$ H_1: $\mu \neq 100$
2. $\alpha = .05$ **two-tailed** $z = \pm 1.96$
3. $\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}} = \frac{15}{\sqrt{20}} = \frac{15}{4.4721} = 3.35$
4. $z = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}} = \frac{97.3 - 100}{3.35} = \frac{-2.7}{3.35} = -0.80$
5. **Accept the H_0**